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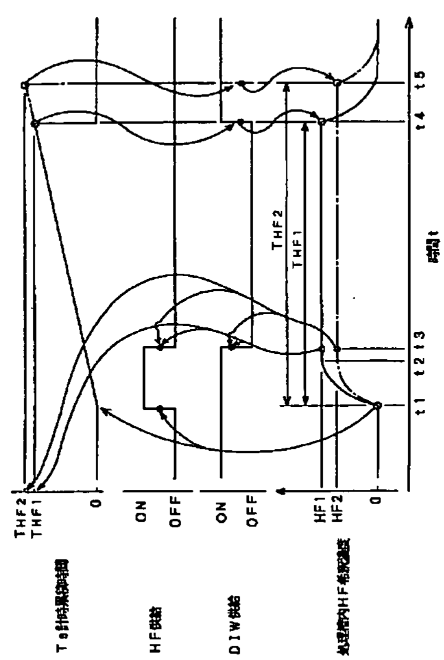
(54)【発明の名称】　基板処理装置

(57)【要約】

【目的】　基板処理液の取扱いの簡略化と基板処理品質の維持とを図る。

【構成】　基板処理装置１０は、純水で満たされている処理槽１２へのＨＦ水溶液の供給が開始されて処理槽１２内におけるＨＦ水溶液置換および希釈ＨＦ水溶液の調製が開始されると、その時の時間ｔ１からの経過時間Ｔｓの計時を開始する。そして、処理槽１２が希釈ＨＦ水溶液で置換されて希釈済みのＨＦ水溶液が処理槽１２からオーバーフローすると、処理槽１２への純水およびＨＦ水溶液の供給を停止してそのままの状態を維持する。そして、オーバーフローした時間ｔ３で希釈ＨＦ水溶液の希釈濃度を検出し、その結果に応じて基板浸漬時間ＴHFを定める。次いで、この基板浸漬時間ＴHFが時間ｔ１から経過すると、純水のみの供給を開始して処理槽１２を純水置換し、基板の浸漬処理を中止し純水洗浄を行なう。



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【特許請求の範囲】

【請求項１】　基板を収納し、純水と基板処理液の供給を受けて該基板処理液の希釈溶液に前記基板を浸漬して処理するための処理槽と、

該処理槽に純水を供給する純水供給手段と、

前記処理槽に基板処理液を供給する基板処理液供給手段と、

該基板処理液供給手段と前記純水供給手段とを制御して、前記純水と基板処理液との前記処理槽への供給および供給停止を図り、前記処理槽を純水で満たした後に前記処理槽から槽内液がオーバーフローするように前記処理槽における純水を前記基板処理液で置換して、前記基板処理液を希釈調製する制御手段とを有する基板処理装置であって、

前記制御手段は、

前記基板処理液供給手段により供給された基板処理液による前記処理槽における純水の置換が開始されてからの経過時間を計時する計時部と、

前記基板処理液の濃度と前記処理槽での基板の基板浸漬時間とを対応付けて記憶する記憶部と、

前記基板処理液の濃度を検出する基板処理液濃度検出部と、

該基板処理液濃度検出部の検出した前記基板処理液の希釈調製時における基板処理液濃度と前記記憶部の記憶結果とに応じて、前記希釈調製済みの基板処理液による基板浸漬時間を決定する浸漬時間決定部と、

前記計時部が該決定した基板浸漬時間の経過を計時すると、前記希釈調製済みの基板処理液での基板浸漬を中止する基板浸漬中止部とを備えることを特徴とする基板処理装置。

【請求項２】　請求項１記載の基板処理装置であって、

前記基板浸漬中止部は、前記計時部が該決定した基板浸漬時間の経過を計時すると、前記純水供給手段を制御して前記処理槽内の前記希釈調製済みの基板処理液を純水で置換するものである基板処理装置。

【請求項３】　請求項１記載の基板処理装置であって、

前記純水供給手段と前記基板処理液供給手段は、純水又は基板処理液を前記処理槽にその底部から供給するものであり、

前記基板処理液濃度検出部は、前記処理槽からオーバーフローする槽内液における基板処理液濃度を検出するものである基板処理装置。

【請求項４】　請求項１ないし３のいずれか記載の基板処理装置であって、

前記処理槽における槽内液の温度を検出する温度検出部と、

前記決定した基板浸漬時間を該検出した槽内液温度に応じて補正する浸漬時間補正部とを有する基板処理装置。

【発明の詳細な説明】

【０００１】

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【産業上の利用分野】本発明は、半導体ウエハや液晶パネル用のガラス基板といった種々の基板を、処理槽において基板洗浄やエッチング等の基板処理液の希釈溶液に浸漬して処理する基板処理装置に関する。

【０００２】

【従来の技術】従来、この種の基板処理装置、例えばフッ酸（以下、ＨＦという）にて基板をエッチング処理に付す基板処理装置では、基板を処理槽に収納しておき、この処理槽に純水とＨＦ水溶液とを供給してＨＦ水溶液の希釈溶液を調製し、この希釈ＨＦ水溶液に基板を所定の時間浸漬することで基板処理、即ちエッチングを行なう。また、基板を洗浄する基板処理装置では、ＨＦ水溶液に替わり、過酸化水素水やアンモニア水等の薬液（基板処理液）を処理槽に供給し、これら薬液の希釈溶液で基板処理たる基板洗浄を行なう。

【０００３】このような基板処理装置にあっては、その基板処理の品質は、処理槽における基板処理液の希釈調製濃度に依存することがよく知れられている。このため、純水や基板処理液の供給に当たり、種々の技術が提案されている。例えば、実開平４－９９２６９には、純水の供給管路において基板処理液を純水に混合して希釈調製し、その希釈調製後の基板処理液の供給量を測定して基板処理液の測定供給量が予め設定された供給量になるように、基板処理液の供給量を調節する技術が提案されている。また、実開平５－５３２４１には、純水の供給管路において基板処理液を純水に混合して希釈調製し、希釈調製後の基板処理液の濃度を検出してその検出濃度が予め設定された濃度になるように、基板処理液の供給量を調節する技術がそれぞれ提案されている。そして、これら従来の技術は、基板処理液の供給量の調節を経て基板処理液の希釈調製濃度を所定濃度にし、基板処理の品質を維持する。

【０００４】

【発明が解決しようとする課題】しかしながら、上記の従来の基板処理装置にあっても、基板処理品質の低下が見られることがあった。上記したように基板処理液の供給量調節を行なっているにも拘らず基板処理品質が低下するのは、次のように考えることができる。

【０００５】基板処理液は純水により希釈されていることから、純水の供給量や供給圧力が変動すれば、基板処理液の供給量が一律でも純水との流量比が変化してその希釈濃度は変化してしまう。この純水の供給に関する変動は、基板処理装置に対する１次側である純水供給装置での供給能力や純水を使用する他の装置の稼働状況に左右されるため、不可避的に起きるおそれがある。なお、純水の供給管路に流量制御弁等を設置して流量制御しても、純水供給圧の圧力変動をなくすことはできないため、本質的な解決にはならない。

【０００６】つまり、上記の従来の技術のように基板処理液の供給量の調節を通した基板処理液の希釈調製を行

なって基板を所定の時間だけ希釈基板処理液に浸漬しただけでは、純水供給側に起因する基板処理液の希釈濃度変化により、エッチング量や洗浄薬液による異物除去程度が不均一となり基板処理品質の低下をもたらす虞がある。

【０００７】また、純水の供給側にその供給量や圧力変動がない場合であっても、純水に混合する元の基板処理液の濃度が変化すると、より具体的に説明すると、基板処理液の貯留容器を交換する都度或いは当該容器に新たな基板処理液を補給する都度にその濃度が変化すると、基板処理液の供給量を一律にしても純水との混合後の希釈濃度は変化する。よって、このような場合にも基板処理品質が低下する虞があるので、基板処理液自体や補給等の都度の厳しい濃度管理を必要とし、基板処理液の扱いが煩雑である。更に、基板処理液の管路における圧送ポンプに印加される電圧に変動が起きると、当該ポンプによる流量に変動をきたしてやはり希釈濃度が変化することがある。

【０００８】本発明は、上記問題点を解決するためになされ、基板処理液の取扱いの簡略化と基板処理液の希釈溶液で基板を処理する際の処理品質の維持とを図ることを目的とする。

【０００９】

【課題を解決するための手段】かかる目的を達成するために請求項１記載の基板処理装置が採用した手段は、基板を収納し、純水と基板処理液の供給を受けて該基板処理液の希釈溶液に前記基板を浸漬して処理するための処理槽と、該処理槽に純水を供給する純水供給手段と、前記処理槽に基板処理液を供給する基板処理液供給手段と、該基板処理液供給手段と前記純水供給手段とを制御して、前記純水と基板処理液との前記処理槽への供給および供給停止を図り、前記処理槽を純水で満たした後に前記処理槽から槽内液がオーバーフローするように前記処理槽における純水を前記基板処理液で置換して、前記基板処理液を希釈調製する制御手段とを有する基板処理装置であって、前記制御手段は、前記基板処理液供給手段により供給された基板処理液による前記処理槽における純水の置換が開始されてからの経過時間を計時する計時部と、前記基板処理液の濃度と前記処理槽での基板の基板浸漬時間とを対応付けて記憶する記憶部と、前記基板処理液の濃度を検出する基板処理液濃度検出部と、該基板処理液濃度検出部の検出した前記基板処理液の希釈調製時における基板処理液濃度と前記記憶部の記憶結果とに応じて、前記希釈調製済みの基板処理液による基板浸漬時間を決定する浸漬時間決定部と、前記計時部が該決定した基板浸漬時間の経過を計時すると、前記希釈調製済みの基板処理液での基板浸漬を中止する基板浸漬中止部とを備えることをその要旨とする。

【００１０】この場合、請求項２記載の基板処理装置では、前記基板浸漬中止部を、前記計時部が該決定した基板浸漬時間の経過を計時すると、前記純水供給手段を制御して前記処理槽内の前記希釈調製済みの基板処理液を純水で置換するものとした。

【００１１】請求項３記載の基板処理装置では、前記純水供給手段と前記基板処理液供給手段を、純水又は基板処理液を前記処理槽にその底部から供給するものとし、前記基板処理液濃度検出部を、前記処理槽からオーバーフローする槽内液における基板処理液濃度を検出するものとした。

【００１２】請求項４記載の基板処理装置では、前記処理槽における槽内液の温度を検出する温度検出部と、該検出した槽内液温度に応じて前記決定した基板浸漬時間を補正する浸漬時間補正部とを有する。

【００１３】

【作用】上記構成を有する請求項１記載の基板処理装置では、制御手段の浸漬時間決定部により、基板処理液濃度検出部が基板処理液の希釈調製時において検出した基板処理液濃度と記憶部の記憶結果とに応じて、希釈調製済みの基板処理液による基板浸漬時間を決定する。このため、何らかの原因で、例えば純水の供給量や供給圧力が変動したり、純水による希釈前の基板処理液の濃度が変化したりして基板処理液の希釈調製濃度が変化しても、その変化した希釈濃度に応じた基板浸漬時間が決定される。

【００１４】その一方で、計時部は、基板処理液供給手段により供給された基板処理液によって処理槽における純水の置換が開始されてからの経過時間を計時しており、当該純水の置換開始から浸漬時間決定部の決定した基板浸漬時間が経過したと計時部により計時されると、希釈調製済みの基板処理液での基板浸漬が基板浸漬中止部により中止される。よって、基板は、基板処理液の希釈濃度に応じて決定された基板浸漬時間に渡って当該希釈調製濃度の基板処理液での浸漬処理を受け、その後は希釈調製濃度の基板処理液での処理には付されない。

【００１５】請求項２記載の基板処理装置では、希釈調製済みの基板処理液での基板浸漬の中止を、純水供給手段の制御を通した処理槽内の希釈調製済みの基板処理液の純水置換で行なう。よって、基板は、基板処理液の希釈濃度に応じて決定された基板浸漬時間に渡って当該希釈調製濃度の基板処理液での浸漬処理の後は、純水置換を通して処理槽内で基板処理液の洗浄に付される。

【００１６】請求項３記載の基板処理装置では、処理槽への純水と基板処理液の供給を処理槽の底部から行ない、基板処理液の濃度を処理槽からオーバーフローする槽内液にて検出する。このオーバーフローする槽内液は、純水と基板処理液の供給が処理槽底部からのものであることから、基板処理液と純水とが十分に混合して基板処理液が均一に希釈済みの溶液となり、基板処理液の希釈濃度が正確に反映する。よって、正確な希釈濃度の検出を通して、基板処理液の希釈濃度と基板浸漬時間と

を正確に対応して基板浸漬時間を決定する。
【0017】請求項4記載の基板処理装置では、温度検出部の検出した処理槽における槽内液温度に応じて浸漬時間補正部により基板浸漬時間を補正するので、基板処理液の温度の変化による基板処理品質の変動を抑制する。
【0018】
【実施例】次に、本発明に係る基板処理装置の好適な実施例について、図面に基づき説明する。図1は、基板を希釈HF水溶液に浸漬してエッチングする基板処理装置10の構成を模式的に示す概略構成図である。
【0019】図示するように、基板処理装置10は、石英ガラスで形成された処理槽12を備え、図示しないキャリアを用いて処理槽12の内部に収納した基板Wを、純水で希釈された希釈HF水溶液に浸漬してエッチング処理する。この処理槽12の開口部には、当該槽をオーバーフローした槽内液が流れ込むオーバーフロー槽14が当該開口部を取り囲むように設けられている。また、処理槽12には、純水（DIW）或いは希釈HF水溶液を槽内に噴出する左右一対のノズル16が処理槽底部に設置されており、処理槽側壁には、槽内液の温度を検出する温度センサ17が設置されている。一方、オーバーフロー槽14には、当該層にオーバーフローした槽内液におけるHF水溶液濃度を検出するHF濃度検出センサ15が設置されている。なお、HF濃度検出センサ15としては、電荷型のセンサや光透過型のセンサ等を用いることができる。
【0020】ノズル16は、純水等の噴出に当たり、槽内に不規則な対流を生じないようなノズル開口位置やノズル形状とされており、処理槽12と同じく石英ガラスから形成されている。また、オーバーフロー槽14に流れ込んだ槽内液は、ドレン管路19を経て排出される。
【0021】処理槽12の各ノズル16には、純水供給装置18から純水を供給するための純水供給管路20が分岐して配管されている。この純水供給管路20には、当該管路を流れる純水流量を制御する流量制御弁22と、その流量を検出する流量検出センサ24が設けられている。なお、この流量制御弁22は、純水供給管路20を遮断して純水流量を0とすることも可能である。
【0022】また、純水供給管路20には、密閉されたHF水溶液貯留タンク26からHF水溶液を供給するためのHF供給管路28が、処理槽12の近傍において分岐して配管されている。HF供給管路28には、当該管路を流れるHF水溶液の流量を制御する流量制御弁30と、その流量を検出する流量検出センサ32が設けられている。なお、この流量制御弁30も、流量制御弁22と同様、管路を遮断してその流量を0とすることができる。
【0023】このほか、純水供給管路20には、処理槽12に至る手前に当該地点の管路をHF水溶液が通過したことを検出するHF通過検出センサ33が設置されている。このHF通過検出センサ33は、HF水溶液の通過検出を通して、処理槽12内に供給されたHF水溶液による当該槽内の純水のHF水溶液（希釈HF水溶液）置換が開始されたことを判断するために用いられる。この場合、HF通過検出センサ33は、管路を通過する流体が純水のみであるか或いはHF水溶液が混合した純水であるかを検出すればHF水溶液の管路通過を検出できる。よって、HF通過検出センサ33には、電荷型のセンサや光透過型のセンサ等のHF水溶液濃度検出センサのほか、phセンサ等を用いることができる。
【0024】HF水溶液貯留タンク26には、加圧された窒素ガスをタンク内に加圧供給する窒素ガス供給装置34が、窒素ガス供給管路36を介して接続されている。この窒素ガス供給管路36には、当該管路を流れる窒素ガスの流量を制御する流量制御弁38が設けられている。なお、この流量制御弁38も、流量制御弁22と同様、管路を遮断してその流量を0とすることができる。
【0025】従って、流量制御弁30によりHF供給管路28を遮断した状態で流量制御弁22により純水供給管路20を開くことで、処理槽12の底部のノズル16から純水のみを処理槽12に供給して、処理槽12を純水で満たすことができる。また、純水供給管路20に純水を流しつつ流量制御弁30によりHF供給管路28を開けば、処理槽12には、その上流で純水とHF水溶液とが混合し純水で希釈された希釈HF水溶液が供給される。そして、希釈HF水溶液の供給を継続することで、処理槽12に満たされていた純水は、希釈HF水溶液で徐々に置換されてオーバーフロー槽14にオーバーフローし、やがて処理槽12内は希釈HF水溶液で満たされる。
【0026】また、更に希釈HF水溶液が供給されると、希釈HF水溶液はオーバーフロー槽14にオーバーフローする。この場合、混合状態の純水とHF水溶液とが処理槽12の底部から供給されることから、処理槽12においても純水とHF水溶液との混合が進んでHF水溶液の希釈濃度は均一となり、こうして希釈濃度が均一となった希釈HF水溶液がオーバーフロー槽14にオーバーフローすることになる。なお、ここでいう均一な希釈濃度とは、設定された希釈濃度に対して均一となったことを意味するものではなく、処理槽12に混合供給された純水とHF水溶液とでその都度定まる希釈濃度を意味する。
【0027】上記したHF水溶液の供給は、窒素ガス供給装置34から窒素ガス供給管路36を経たHF水溶液貯留タンク26への窒素ガスの加圧供給によりタンク内圧の上昇により、行なわれる。この際、流量制御弁38にて流量調整がされる。
【0028】次に、上記した基板処理装置10における

純水やＨＦ水溶液の供給制御を司る電子制御装置４０について説明する。

【００２９】この電子制御装置４０には、信号入力機器として、純水供給管路２０やＨＦ供給管路２８における流量を検出する流量検出センサ２４，流量検出センサ３２の他、処理槽１２における温度センサ１７とオーバーフロー槽１４におけるＨＦ濃度検出センサ１５と純水供給管路２０におけるＨＦ通過検出センサ３３とが接続されており、上記各センサの検出信号は電子制御装置４０に入力される。また、制御信号出力機器として、流量制御弁２２や流量制御弁３０，流量制御弁３８が接続されており、各制御弁には電子制御装置４０から制御信号が出力される。

【００３０】これら検出信号等に基づき上述した流量制御弁２２等に制御信号を出力する電子制御装置４０は、ＣＰＵ４２，ＲＯＭ４４，ＲＡＭ４６，タイマ４８を中心に論理演算回路として構成され、これらとコモンバス５０を介して相互に接続された入出力ポート５２により外部との入出力を行う。

【００３１】次に、上記した構成を備える本実施例の基板処理装置１０の電子制御装置４０が行う基板浸漬処理制御（ルーチン）について、図２のフローチャートに基づき説明する。

【００３２】図２に示す基板浸漬処理ルーチンは、図示しない基板搬送装置により基板Ｗが処理槽１２の所定位置に投入されてその収納が完了し、基板搬送装置から電子制御装置４０が収納完了信号を受けると実行される。そして、処理が開始されると、まず、処理槽１２への純水の供給を開始する（ステップＳ１００）。この際、電子制御装置４０からは、純水供給管路２０における流量制御弁２２に制御流量を定めた制御信号が出力されるので、純水は流量制御弁２２によりその流量が制御されて処理槽１２に単独で供給される。

【００３３】続いて、処理槽１２が純水で満たされたか否か、即ち純水が処理槽１２からオーバーフロー槽１４にオーバーフローしたか否かを判断し（ステップＳ１０５）、肯定判断するまで待機する。このステップＳ１０５で否定判断して待機している間にも純水の供給は継続されているので、やがて処理槽１２は純水で満たされて純水はオーバーフロー槽１４にオーバーフローし、ステップＳ１０５では肯定判断がなされることになる。具体的には、以下のようにして純水のオーバーフローが判断される。

【００３４】処理槽１２の内容積は基板処理装置１０の設計段階において定まるので、流量検出センサ２４の検出した流量或いは電子制御装置４０から指令した制御流量を用いることで、純水が処理槽１２に供給されてからオーバーフロー槽１４にオーバーフローするまでに要する時間（純水オーバーフロー時間）は演算できる。よって、ステップＳ１００で純水の供給を開始してからこの純水オーバーフロー時間を経過すれば、純水のオーバーフローが起きたといえステップＳ１０５での判断が肯定判断となる。なお、ドレン管路１９における流体通過の状況等から純水のオーバーフローの有無を判断するよう構成することもできる。

【００３５】ステップＳ１０５で肯定判断した後は、ＨＦ水溶液を純水で満たされた処理槽１２に供給して希釈し希釈ＨＦ水溶液を調製すべく、処理槽１２へのＨＦ水溶液の供給を開始する（ステップＳ１１０）。この際、電子制御装置４０からは、窒素ガス供給管路３６における流量制御弁３８およびＨＦ供給管路２８における流量制御弁３０にそれぞれの制御流量を定めた制御信号が出力される。よって、ＨＦ水溶液は、これら流量制御弁によりその流量が制御されて純水供給管路２０に混入し、その下流範囲の純水供給管路２０を経て処理槽１２に純水とともに供給される。このため、ＨＦ水溶液は、純水に純水供給管路２０において希釈されながら処理槽１２に供給されることになる。なお、以下の各ステップの説明に際しては、図３に示すタイミングチャートを適宜援用しつつ各処理について説明することとする。

【００３６】ステップＳ１１０により図３に示す時間ｔ１においてＨＦ水溶液の供給が開始されると、続くステップＳ１１５では、ＨＦ通過検出センサ３３の検出信号に基づき処理槽１２にＨＦ水溶液が実際に供給されたか否かを判断し、肯定判断するまで待機する。この処理は実際にＨＦ水溶液が処理槽１２に供給されたかを確認するためのものである。このため、図１に示すように、ステップＳ１１０でＨＦ水溶液の供給を開始すれば即座にＨＦ水溶液が処理槽１２に到達するような場合や、ＨＦ供給管路２８が直接ノズル１６に配管されているような図示しない構成の場合には、ステップＳ１１５を省略することもできる。なお、以下の説明に当たっては、特に明示しない限り、ＨＦ水溶液の供給を開始すれば即座にＨＦ水溶液が処理槽１２に到達することとする。

【００３７】このステップＳ１１５で処理槽１２にＨＦ水溶液が実際に供給されたと肯定判断すれば、処理槽１２においての貯留済み純水によるＨＦ水溶液の希釈および貯留済み純水の希釈ＨＦ水溶液置換が開始されることになる。よって、図３に示すように、時間ｔ１においてステップＳ１１５で肯定判断すると、処理槽１２にＨＦ水溶液が純水とともに実際に供給されてからの経過時間（混合供給時間）Ｔsのタイマ４８による計時を時間ｔ１から開始する（ステップＳ１２０）。その後は、純水で希釈された希釈ＨＦ水溶液で処理槽１２が満たされたか否か、即ち貯留済みの純水は処理槽１２から総てオーバーフロー槽１４にオーバーフローし更に当該希釈ＨＦ水溶液もオーバーフロー槽１４にオーバーフローしたか否かを判断し（ステップＳ１２５）、肯定判断するまで待機する。

【００３８】ところで、ＨＦ供給管路２８が処理槽１２

から離れて純水供給管路２０に接続されているためにＨＦ水溶液の供給が開始されても供給開始後即座に処理槽１２には到達しない場合には、次のようになる。つまり、ステップＳ１１０でＨＦ水溶液の供給を開始してからＨＦ水溶液が処理槽１２に到達するまでの時間△ｔは、純水やＨＦ水溶液の流量，管内流速およびＨＦ供給管路２８の接続箇所から処理槽１２までの管路長等により定まる。よって、ＨＦ水溶液がその供給開始後即座に処理槽１２には到達しない場合には、ステップＳ１２５においてタイマ４８による経過時間Ｔs の計時を開始する時間ｔ1 より上記の時間△ｔだけ前にステップＳ１１０を行なえばよい。この際、ステップＳ１００でＨＦ水溶液の供給を開始した後のステップＳ１１５により時間ｔ1 は特定されるので、上記の時間△ｔを演算したりする必要はない。

【００３９】上記したステップＳ１２５で否定判断して待機している間にも純水とＨＦ水溶液との供給は継続されている。このため、やがて貯留済みの純水は総て希釈ＨＦ水溶液に置換され、処理槽１２はこの希釈ＨＦ水溶液で満たされて希釈ＨＦ水溶液はオーバーフロー槽１４にオーバーフローし、ステップＳ１２５では肯定判断がなされることになる。この場合、ステップＳ１０５と同様にして希釈ＨＦ水溶液のオーバーフローが判断される。

【００４０】つまり、まず、処理槽１２の内容積と、流量検出センサ２４，流量検出センサ３２の検出した純水およびＨＦ水溶液の流量或いは電子制御装置４０から指令した制御流量とを用いてＨＦ水溶液オーバーフロー時間を演算する。そして、ＨＦ水溶液が処理槽１２に実際に供給された時間ｔ1 からこの演算したＨＦ水溶液オーバーフロー時間が経過した時間を、希釈ＨＦ水溶液のオーバーフローが起きた時間ｔ2 とする。なお、本実施例では、この時間ｔ2 より所定時間だけ経過した時間ｔ3 においてステップＳ１２５で肯定判断するよう構成されている。

【００４１】また、このステップＳ１２５での判断を次のように下すよう構成することもできる。処理槽１２へのＨＦ水溶液の供給は処理槽１２が既に純水にて満たされた状況下で開始されるので、図３に示すように、その供給開始時点（時間ｔ1 ）からの時間の経過とともに貯留済み純水はＨＦ水溶液に置換されていく。このため、処理槽１２内のＨＦ水溶液の希釈濃度は、時間の経過とともに上昇し、やがて安定する。つまり、処理槽１２内のＨＦ水溶液の希釈濃度は、処理槽１２が希釈ＨＦ水溶液で満たされて希釈ＨＦ水溶液がオーバーフローするようになると、処理槽１２に混合供給される純水とＨＦ水溶液の実際の流量比やＨＦ水溶液貯留タンク２６におけるＨＦ水溶液濃度等によりその都度定まる希釈濃度（ＨＦ１）に安定する。よって、オーバーフロー槽１４に設けたＨＦ濃度検出センサ１５を図示しない計測ルーチンで所定時間ごとにスキャンし、そのスキャンごとの検出濃度差がごく小さな値に推移すると計測ルーチンから希釈ＨＦ水溶液のオーバーフローが起きた旨の制御信号を出すよう構成する。そして、この制御信号を受けた時点（時間ｔ3 ）においてステップＳ１２５で肯定判断するよう構成する。

【００４２】ステップＳ１２５での肯定判断に続いては、流量制御弁２２，流量制御弁３０および流量制御弁３８に流量０の制御信号を出力して、処理槽１２への純水およびＨＦ水溶液の供給を停止する（ステップＳ１３０）。よって、その後は、処理槽１２は上記した希釈濃度ＨＦ１でその希釈濃度が均一となった希釈ＨＦ水溶液で満たされたままの状態となり、基板Ｗはこの希釈濃度ＨＦ１の希釈ＨＦ水溶液に浸漬されてエッチングされる。

【００４３】次に、この希釈濃度ＨＦ１のＨＦ濃度検出センサ１５からの読み込み（ステップＳ１４０）と、処理槽１２内における希釈ＨＦ水溶液の温度（槽内液温）の温度センサ１７からの読み込み（ステップＳ１５０）とを実行する。その後、読み込んだ希釈濃度ＨＦ１に基板Ｗを浸漬する基板浸漬時間T_{HF}を次のようにして算出する（ステップＳ１６０）。

【００４４】まず、読み込んだ希釈濃度ＨＦ１と、図４に示すＨＦ水溶液濃度と基板浸漬時間T_{HF}のグラフに対応するマップから補間計算を経て一旦基板浸漬時間を算出する。このグラフは、同一の基板エッチング量を得る際に、ＨＦ水溶液濃度と浸漬時間とを予め実験的に定めたものであり、当該グラフに対応するマップは、ＲＯＭ４４に記憶されている。次に、この算出した基板処理時間を読み込んだ槽内液温により補正した値を、読み込んだ希釈濃度ＨＦ１に基板Ｗを実際に浸漬する基板浸漬時間T_{HF1}とする。よって、何らかの原因、例えば純水供給量や供給圧力の変動等により純水とＨＦ水溶液の流量比などが変わり、新たに読み込んだ希釈濃度が図３に示すように前回の希釈濃度ＨＦ１より低い希釈濃度ＨＦ２であれば、この希釈濃度ＨＦ２に基板Ｗを実際に浸漬する基板浸漬時間T_{HF}は、T_{HF1}より長い基板浸漬時間T_{HF2}として算出される。

【００４５】なお、同一の希釈濃度の希釈ＨＦ水溶液であっても、その液温が高ければ浸漬によるエッチングはより進行することから、槽内液温による基板浸漬時間T_{HF}の補正を行なう。つまり、槽内液温が基準となる液温に比べて高ければ基板処理時間を減少側に補正し、低ければ増大側に補正する。

【００４６】こうして温度補正演算を経て基板浸漬時間T_{HF}を算出すると、この算出した基板浸漬時間T_{HF}（T_{HF1}，T_{HF2}）が、処理槽１２にＨＦ水溶液を供給を開始してから経過したか否かを、タイマ４８の計時する経過時間Ｔs を介して判断する（ステップＳ１６５）。そして、経過時間Ｔs が算出した基板浸漬時間T_{HF}（T_{HF}

１，ＴHF2 ）に達していないと否定判断している間は待機する。

【００４７】従って、ステップＳ１６５で否定判断して待機している時間に亘って基板Ｗは希釈ＨＦ水溶液に浸漬されてエッチングされ、そのエッチング量たる処理品質を左右する基板浸漬時間ＴHFは、希釈ＨＦ水溶液のその時の実際の希釈濃度によりその都度変更される。具体的には、希釈ＨＦ水溶液の希釈濃度がＨＦ１であれば基板Ｗは基板浸漬時間ＴHF1 に亘って浸漬され、希釈濃度がＨＦ２であれば基板Ｗは基板浸漬時間ＴHF2 に亘って浸漬されることになる。

【００４８】一方、ステップＳ１６５でＴｓ＝基板浸漬時間ＴHF（ＴHF1，ＴHF2 ）であると判断すれば、経過時間Ｔｓに値０をセットし（ステップＳ１７０）、次いで、それまで中止されていた純水の供給を開始する（ステップＳ１８０）。つまり、希釈ＨＦ水溶液の希釈濃度がＨＦ１であれば基板浸漬時間ＴHF1 に亘る基板浸漬を経た時間ｔ４（ｔ１＋ＴHF1 ）の後には、また、希釈濃度がＨＦ２であれば基板浸漬時間ＴHF2 に亘る基板浸漬を経た時間ｔ５（ｔ１＋ＴHF2 ）の後には、当該希釈濃度（ＨＦ１，ＨＦ２）での基板Ｗの浸漬処理は中止されることになる。そして、時間ｔ４又は時間ｔ５の後からは、純水の供給により処理槽１２内の希釈ＨＦ水溶液が純水に置換されやがて処理槽１２は純水で満たされるので、この間に基板Ｗは純水にて洗浄される。

【００４９】このステップＳ１８０において純水の供給を開始する際には、その流量を次のように制御する。処理槽１２に純水が供給されると、処理槽１２内は希釈ＨＦ水溶液から徐々に純水に置換されるため、置換開始（時間ｔ４又は時間ｔ５）からのＨＦ水溶液濃度は、図３に示すように、推移する。この純水置換の時の様子を、処理槽１２内がＨＦ水溶液で置換される際の様子と合わせて図５に示す。なお、純水置換については、置換開始が時間ｔ４の場合についてのみ示す。

【００５０】この図５に示すように、時間ｔ４で純水置換が開始されてからも処理槽１２にはＨＦ水溶液が残っているので、純水置換の開始後にも、基板Ｗは、処理槽１２に残存する残存希釈ＨＦ水溶液にてエッチングされていると考えられる。より詳しく説明すると、基板Ｗは、時間ｔ４からＨＦ水溶液の濃度がゼロとなる時間ｔ６までの間に亘って、その濃度が基板浸漬時間における希釈濃度ＨＦ１よりは低く且つ次第に低下する残存希釈ＨＦ水溶液にてエッチングされていると考えられる。そして、この間のエッチング量（過剰エッチング量）は、幾何的に表わすと、図５中に斜線で示す範囲の面積Ｓ１に相当する。

【００５１】その一方で、処理槽１２にＨＦ水溶液を供給する基板処理開始時には、時間ｔ１で希釈ＨＦ水溶液置換が開始されてからも処理槽１２には純水が残っている。このため、時間ｔ１からＨＦ水溶液の濃度が希釈濃度ＨＦ１となる時間ｔ２までの間においては、基板Ｗは、濃度ゼロから基板浸漬時間における希釈濃度ＨＦ１に次第に増加する希釈ＨＦ水溶液にてエッチングされていると考えられる。そして、この間のエッチング不足量（希釈濃度ＨＦ１のＨＦ水溶液による時間ｔ１から時間ｔ２までの間のエッチング量と、希釈濃度ＨＦ１に次第に増加する濃度の希釈ＨＦ水溶液による時間ｔ１から時間ｔ２までの間のエッチング量との差）は、幾何的に表わすと、図５中に斜線で示す範囲の面積Ｓ０に相当する。

【００５２】従って、ステップＳ１８０では、上記した過剰エッチング量とエッチング不足量とが等しくなるよう、具体的には図５中の面積Ｓ１と面積Ｓ０とが一致するように、純水供給の際の純水流量を制御する。

【００５３】上記したような純水流量の制御を伴うステップＳ１８０に続いては、基板Ｗの純水による洗浄が完了したか否かを時間ｔ４又は時間ｔ５からの所定時間の経過を介して判断し（ステップＳ１８５）、純水洗浄が完了すれば純水の供給を停止する（ステップＳ１９０）。次いで、純水洗浄の完了により処理槽１２における基板Ｗの処理が総て完了したとして基板Ｗを処理槽１２外に取り出すべく、基板搬出指令信号を出力し（ステップＳ２００）、一旦本ルーチンを終了する。図示しない基板搬送装置は、この基板搬出指令信号を受けて、基板Ｗを処理槽１２から搬出する。

【００５４】ところで、既述したようにＨＦ供給管路２８が処理槽１２から離れて純水供給管路２０に接続されているような構成の場合には、ＨＦ供給管路２８の接続箇所から処理槽１２までの純水供給管路２０の管路にはＨＦ水溶液が基板浸漬処理時の希釈濃度のまま残存している。このため、このよう構成の場合には、ステップＳ１８０で純水の供給を開始しても、即座に純水が処理槽１２に到達せず供給開始当初は管内のＨＦ水溶液も供給され、所定時間△ｔ０の後にしか純水が処理槽１２に供給されない。つまり、ステップＳ１８０で純水供給が開始されてから所定時間△ｔ０の経過後に、処理槽内の純水置換が始まる。よって、ＨＦ供給管路２８が処理槽１２から離れて純水供給管路２０に接続されているような構成の場合には、ステップＳ１８０による純水供給を次のように行なえばよい。まず、上記の所定時間△ｔ０を、それまでの純水やＨＦ水溶液の流量，管内流速およびＨＦ供給管路２８の接続箇所から処理槽１２までの管路長等により算出する。そして、処理槽１２内の純水置換が始まる時間ｔ４又は時間ｔ５より所定時間△ｔ０だけ前に、或いは（基板浸漬時間ＴHF－△ｔ０）で演算される時間が時間ｔ１から経過した後に、ステップＳ１８０を実行し、純水供給を時間ｔ４又は時間ｔ５より△ｔ０だけ早めに開始すればよい。なお、この所定時間△ｔ０の算出は、基板浸漬時間内に完了するので支障はない。

【００５５】以上説明したように本実施例の基板処理装置１０は、純水供給量や供給圧力の変動により純水とＨＦ水溶液の流量比が変わったり、ＨＦ水溶液貯留タンク２６の交換によりＨＦ水溶液濃度が変化したりして処理槽１２における希釈ＨＦ水溶液の希釈濃度が基板処理の都度等に変化しても、その変化に応じて基板Ｗの基板浸漬時間Ｔ$_{HF}$を変更して設定する。更に、基板処理装置１０は、処理槽１２における処理の都度の希釈濃度の希釈ＨＦ水溶液での基板浸漬時間Ｔ$_{HF}$に亘る基板Ｗの浸漬を経ると、その後の当該希釈濃度の希釈ＨＦ水溶液での基板浸漬を中止して基板Ｗを純水洗浄に付す。

【００５６】このため、基板Ｗの処理品質であるエッチング量は希釈ＨＦ水溶液の希釈濃度とその浸漬時間により依存することから、本実施例の基板処理装置１０によれば、希釈ＨＦ水溶液の希釈濃度とその浸漬時間との対応を通して、エッチング量の均一化を図りその処理品質を維持することができる。また、基板処理装置１０によれば、ＨＦ水溶液貯留タンク２６の交換によりＨＦ水溶液の濃度が変化してもエッチング量、延いては処理品質を維持できるので、ＨＦ水溶液貯留タンク２６のＨＦ水溶液濃度を厳格に管理する必要がなくなりその取扱いを簡略化することができる。

【００５７】また、基板処理装置１０では、希釈ＨＦ水溶液での基板浸漬後に基板Ｗを純水洗浄に付すので、基板Ｗに希釈ＨＦ水溶液を付着させずに取り出すことができる。よって、基板処理装置１０によれば、基板浸漬後における不用意なエッチングを回避できる。また、純水洗浄済みなので、後工程にとって好都合である。

【００５８】更に、この基板処理装置１０は、処理槽１２への純水とＨＦ水溶液の混合供給をノズル１６により槽の底部から行なう。よって、処理槽１２においても純水とＨＦ水溶液との混合を進め、ＨＦ水溶液の希釈濃度を、その時の純水流量，ＨＦ水溶液流量等で定まる均一の希釈濃度とし、この均一の希釈濃度となった希釈ＨＦ水溶液をオーバーフロー槽１４にオーバーフローさせる。そして、こうして均一化された希釈濃度を、ＨＦ濃度検出センサ１５により処理槽１２からオーバーフローする槽内液（希釈ＨＦ水溶液）にて検出する。このため、基板処理装置１０によれば、処理槽１２における希釈ＨＦ水溶液の正確な希釈濃度の検出を通して正確な基板浸漬時間を設定できるので、エッチング量をより一層均一化させて処理品質の維持・向上を図ることができる。

【００５９】また、基板処理装置１０は、処理槽１２における希釈ＨＦ水溶液の温度により基板Ｗの基板浸漬時間を増減補正して、基板浸漬時間の適正化を図る。よって、基板処理装置１０によれば、処理槽１２における希釈ＨＦ水溶液の温度の変化によるエッチング量の変動を抑制して、処理品質の維持・向上を図ることができる。

【００６０】更に、本実施例の基板処理装置１０では、次のような利点がある。処理槽１２のノズル１６は石英ガラス製であるので、その程度は少ないものの希釈ＨＦ水溶液によりノズル１６のノズル開口が僅かずつ腐食即ちエッチングされる場合がある。従って、基板処理装置１０によれば、希釈ＨＦ水溶液の実際の希釈濃度に応じて基板浸漬時間を定めているで、処理槽１２のノズル１６のノズル開口のエッチング量を基板処理の都度均一なものとすることができる。このため、このような場合においても処理槽１２への純水やＨＦ水溶液の単位時間当たりの流入量に不用意な変動をきたさず、安定した流入量で処理槽１２へ純水やＨＦ水溶液を流入させることができる。

【００６１】また、基板処理装置１０では、図５に示すように、純水置換時における純水流量制御を通して、純水置換時の過剰エッチング量と基板処理開始当初のエッチング不足量とを一致させた。このため、基板処理装置１０によれば、エッチング量のより一層の均一化を通して、高い処理品質の維持を図ることができる。

【００６２】以上本発明の一実施例について説明したが、本発明はこの様な実施例になんら限定されるものではなく、本発明の要旨を逸脱しない範囲において種々なる態様で実施し得ることは勿論である。

【００６３】例えば、ＨＦ通過検出センサ３３により純水の希釈ＨＦ水溶液置換の開始を検出するよう構成したが、ＨＦ通過検出センサ３３を用いることなくこの希釈ＨＦ水溶液置換開始を検出するよう、次のように構成することもできる。

【００６４】基板処理装置１０の設計段階において、純水供給管路２０やＨＦ供給管路２８の有効管路面積や管路長は定まるので、これらの設計値と流量検出センサ２４および流量検出センサ３２の検出流量とから、ＨＦ水溶液の純水供給管路２０への混入開始から処理槽１２へＨＦ水溶液が到達するまでの間の時間（ＨＦ到達時間）は演算できる。よって、流量制御弁３０によりＨＦ水溶液を純水供給管路２０へ混入してからＨＦ到達時間が経過した時点を処理槽１２における純水の希釈ＨＦ水溶液置換開始時として処理すればよい。具体的には、ＨＦ水溶液の純水供給管路２０への混入時からＨＦ到達時間の経過した時点で、ステップＳ１２０における混合供給時間Ｔｓ の計時を行なうよう構成すればよい。このように構成すれば、ＨＦ通過検出センサ３３が不要となり構成の簡略化を図ることができる。

【００６５】更に、上記した実施例では、単一の基板処理液（ＨＦ水溶液）の希釈水溶液で基板処理する場合について説明したが、複数の基板処理液の希釈水溶液で基板処理、例えば過酸化水素水やアンモニア水等の希釈基板処理液で基板処理する場合にも本発明を適用できることは勿論である。この場合には、各基板処理液ごとの濃度を検出すればよい。

【００６６】また、上記した実施例では、ＨＦ水溶液を

純水供給管路２０に混入するよう管路を構成したが、図６に示すように、純水供給管路２０とＨＦ供給管路２８とをそれぞれ個別に処理槽１２に至るよう構成することもできる。この場合には、処理槽１２における純水の希釈ＨＦ水溶液置換開始時が流量制御弁３０による管路開放時として定まるので、ＨＦ通過検出センサ３３が不要となり構成の簡略化を図ることができる。

【００６７】また、上記した実施例では、希釈ＨＦ水溶液での基板浸漬処理が完了後に純水を単独で供給して処理槽１２内を純水置換し基板を洗浄する構成について説明したが、希釈ＨＦ水溶液での基板浸漬処理が完了後に基板Ｗを処理槽１２から取り出したり、処理槽１２内の希釈ＨＦ水溶液を排出するといった構成を採ることもできる。加えて、上記した実施例では、ＨＦ水溶液を処理槽１２に供給する際に純水をも供給する構成について説明したが、ＨＦ水溶液の供給の際には純水の供給を停止して処理槽１２内の純水でＨＦ水溶液を希釈する場合にも適用できることは勿論である。

【００６８】

【発明の効果】以上詳述したように請求項１記載の基板処理装置は、何らかの原因で基板処理の都度の基板処理液の希釈調製濃度が変化しても、その変化に応じてその希釈調製濃度の基板処理液による基板浸漬時間を決定し、この決定した基板浸漬時間が処理槽における基板処理液置換が開始されてから経過すると、希釈調製済みの基板処理液での基板浸漬を中止する。よって、請求項１記載の基板処理装置によれば、実際に基板の浸漬に供される基板処理液の希釈調製濃度と基板浸漬時間との対応を図ることで、基板処理品質を維持することができる。しかも、請求項１記載の基板処理装置では、基板処理液の貯留タンクの交換によりその濃度が変化しても基板の浸漬処理における処理程度、延いては処理品質を維持できる。このため、請求項１記載の基板処理装置によれば、基板処理液自体の濃度を厳格に管理する必要がなくなりその取扱いを簡略化することができる。

【００６９】請求項２記載の基板処理装置は、希釈調製済みの基板処理液での基板浸漬の中止を処理槽内の希釈調製済みの基板処理液の純水置換で行なう。よって、請求項２記載の基板処理装置によれば、基板浸漬処理後の基板に基板処理液を付着させたままとしないので、希釈調製濃度の基板処理液での浸漬処理の後における不用意な基板処理の進行を回避できる。また、純水置換を経て純水洗浄済みなので、後工程にとって好都合である。

【００７０】請求項３記載の基板処理装置では、処理槽底部からの純水と基板処理液の供給を通して希釈調製濃度を均一化させ、均一となった希釈濃度でオーバーフローする基板処理液の希釈調製濃度を検出する。このため、請求項３記載の基板処理装置によれば、正確な希釈調製濃度の検出を通して、基板処理液の希釈濃度と基板浸漬時間とを正確に対応して基板浸漬時間を決定できるので、基板処理の処理品質の向上並びにその維持を図ることができる。

【００７１】請求項４記載の基板処理装置では、基板処理の都度の基板処理液の希釈調製濃度の変化に対応させた基板浸漬時間を、基板処理の都度の槽内液温度にも対応させる。このため、請求項４記載の基板処理装置によれば、基板処理液による処理程度の変動を抑制して、基板処理品質の維持・向上を図ることができる。

【図面の簡単な説明】

【図１】基板を希釈フッ酸溶液に浸漬してエッチングする基板処理装置１０の構成を模式的に示す概略構成図。

【図２】電子制御装置４０が行う基板浸漬処理ルーチンを示すフローチャート。

【図３】基板浸漬処理ルーチンにおける処理の内容を説明するためのタイミングチャート。

【図４】基板浸漬処理ルーチンにおける処理の内容を説明するためのグラフ。

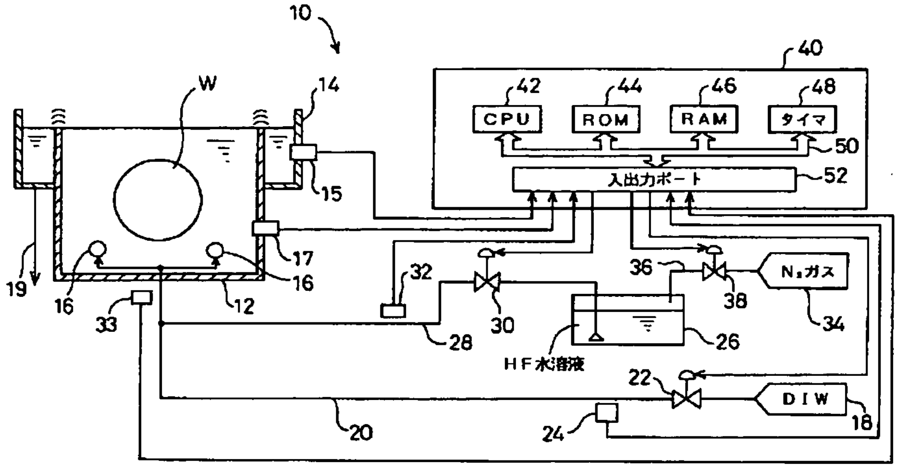
【図５】基板浸漬処理ルーチンにおける処理の内容を説明するための説明図。

【図６】基板処理装置１０の他の実施例の構成を模式的に示す概略構成図。

【符号の説明】

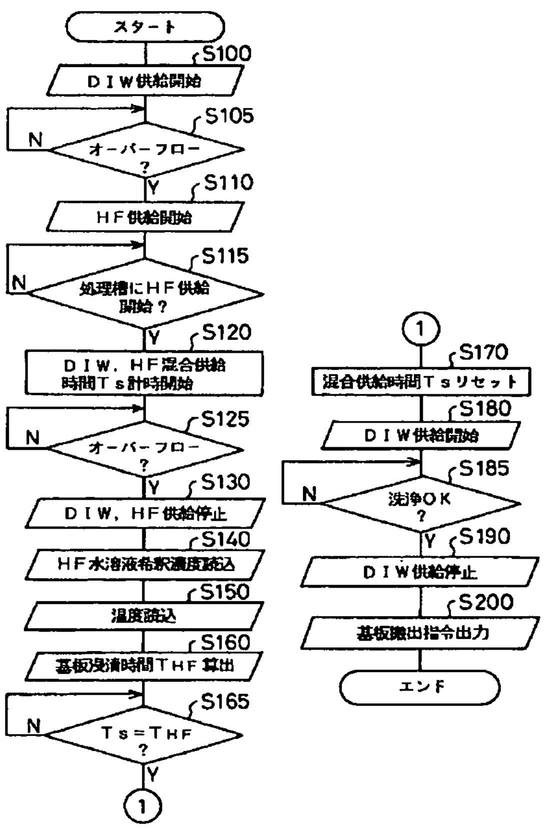
１０…基板処理装置
１２…処理槽
１４…オーバーフロー槽
１５…ＨＦ濃度検出センサ
１６…ノズル
１７…温度センサ
１８…純水供給装置
２０…純水供給管路
２２…流量制御弁
２４…流量検出センサ
２６…ＨＦ水溶液貯留タンク
２８…ＨＦ供給管路
３０…流量制御弁
３２…流量検出センサ
３３…ＨＦ通過検出センサ
３４…窒素ガス供給装置
３６…窒素ガス供給管路
３８…流量制御弁
４０…電子制御装置
４２…ＣＰＵ
４４…ＲＯＭ
４６…ＲＡＭ
４８…タイマ
Ｗ…基板

【図１】



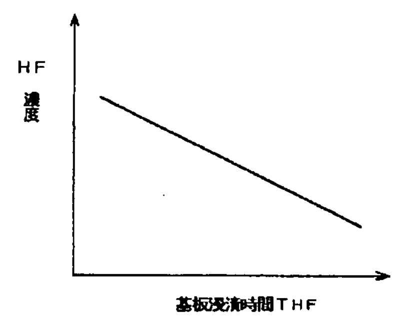
10
W
14
15
17
16
12
19
33
40
42
CPU
44
ROM
46
RAM
48
タイマ
50
入出力ポート
52
32
30
28
36
38
N₂ガス
34
26
HF水溶液
22
DIW
18
20
24

【図２】



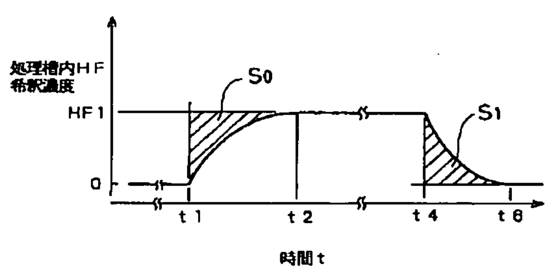
スタート
S100
DIW供給開始
S105
オーバーフロー？
N
Y
S110
HF供給開始
S115
処理槽にHF供給開始？
S120
DIW，HF混合供給時間Ts計時開始
S125
オーバーフロー？
S130
DIW，HF供給停止
S140
HF水溶液希釈濃度読込
S150
温度読込
S160
基板浸漬時間THF算出
S165
Ts＝THF？
1
S170
混合供給時間Tsリセット
S180
DIW供給開始
S185
洗浄OK？
S190
DIW供給停止
S200
基板搬出指令出力
エンド

【図４】



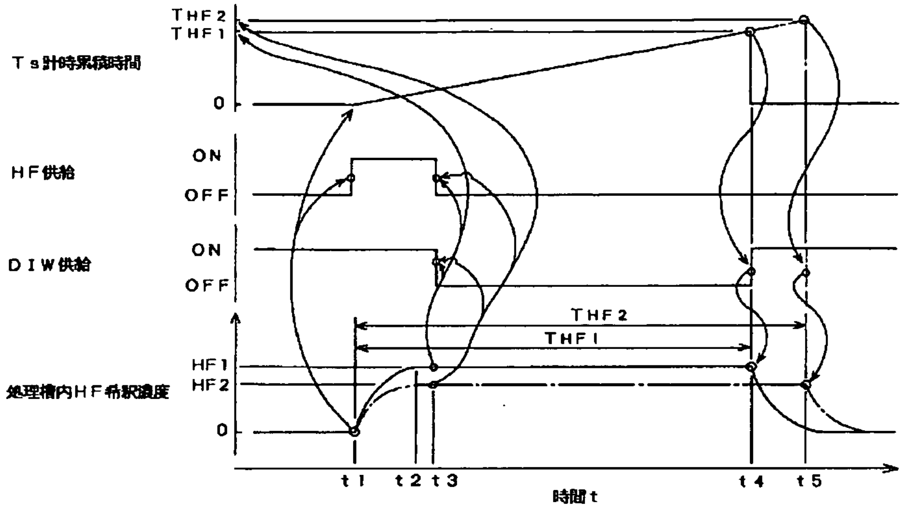
HF濃度
基板浸漬時間THF

【図５】

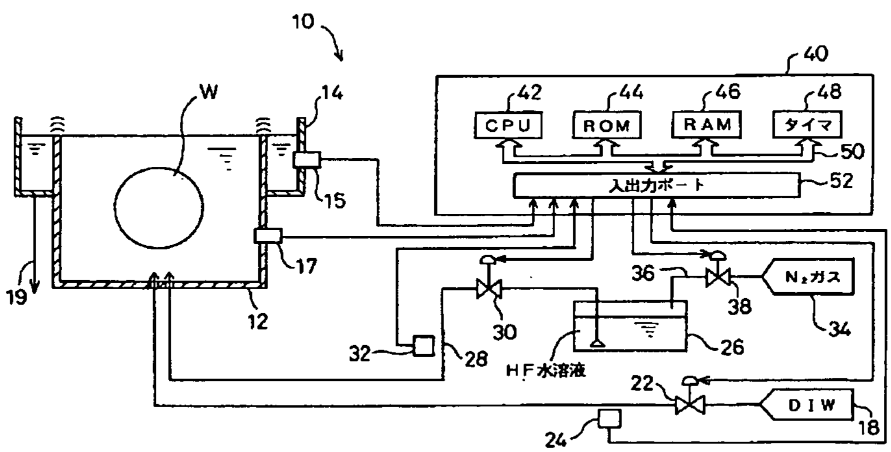


処理槽内HF希釈濃度
S0
S1
HF1
0
t1
t2
t4
t6
時間t

【図3】



【図6】



フロントページの続き

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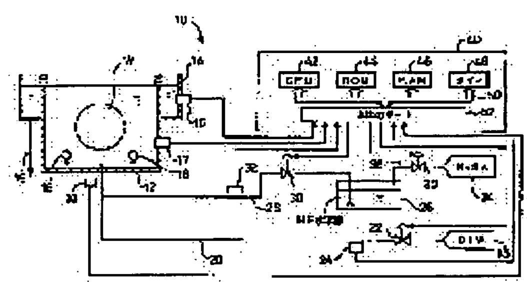
(54) SUBSTRATE TREATMENT DEVICE

(57)Abstract:
PURPOSE: To allow a dilution-adjusted concentration to correspond to a substrate immersion time and thereby maintain a treatment quality at a specific level by determining the substrate immersion time in accordance with a change in the dilution- adjusted concentration of a substrate treatment liquid, and suspending the immersion of a substrate using the substrate treatment liquid whose dilution adjustment is finished, if the substrate immersion time elapsed.



CONSTITUTION: A substrate treatment device 10 etches a substrate W stored in a treatment tank 12 by immersing the substrate in an aqueous HF solution obtained by diluting it by pure water. On the other hand, an electronic control device 40 enters each detection signal from each flow sensor 24, 32 in each pure water and HF feed tubular path 20, 28, the treatment tank 12, a temperature sensor 17, an HF concentration sensor 15 for an overflow tank 14, and an HF passage sensor 33, in the substrate treatment device 10. In addition, the electronic control device 40 controls each flow control valve 22, 30, 38. In this case, the device 40 determines a substrate immersion time in accordance with a change in a dilution-adjusted concentration of a substrate treatment liquid, and at the same time the immersion of the substrate using the substrate treatment liquid is suspended, if the substrate immersion time elapsed after the commencement of displacing the substrate treatment liquid.

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CLAIMS

[Claim(s)]

[Claim 1] The processing tub for containing a substrate, being immersed and processing said substrate to the diluted solution of this substrate processing liquid, in response to supply of pure water and substrate processing liquid, A pure-water supply means to supply pure water to this processing tub, and a substrate processing liquid supply means to supply substrate processing liquid to said processing tub, Control this substrate processing liquid supply means and said pure-water supply means, and supply to said processing tub of said pure water and substrate processing liquid and supply interruption are planned. Said substrate processing liquid permutes the pure water in said processing tub so that liquid in the tank may overflow from said processing tub after filling said processing tub with pure water. It is the substrate processor which has the control means which carries out dilution preparation of said substrate processing liquid. Said control means the time check which clocks the elapsed time after the permutation of the pure water in said processing tub with the substrate processing liquid supplied by said substrate processing liquid supply means is started -- with the section The storage section which matches and memorizes the substrate immersion time amount of the substrate in the concentration and said processing tub of said substrate processing liquid, It responds to the substrate processing liquid concentration detecting element which detects the concentration of said substrate processing liquid, and the substrate processing liquid concentration at the time of dilution preparation of said substrate processing liquid which this substrate processing liquid concentration detecting element detected and the storage result of said storage section. the immersion time amount decision section which decides on substrate immersion time amount with substrate processing liquid [finishing / said dilution preparation], and said time check -- the substrate processor characterized by having the substrate immersion termination section which stops substrate immersion with substrate processing liquid [finishing / said dilution preparation] if the section clocks the this determined substrate immersion passage of time.

[Claim 2] a substrate processor according to claim 1 -- it is -- said substrate immersion termination section -- said time check -- the substrate processor which is what will control said pure-water supply means and will permute substrate processing liquid [finishing / said dilution preparation in said processing tub] with pure water if the section clocks the this determined substrate immersion passage of time.

[Claim 3] It is the substrate processor which is a substrate processor according to claim 1, and is what said pure-water supply means and said substrate processing liquid supply means supply pure water or substrate processing liquid to said processing tub from the pars basilaris ossis occipitalis, and detects the substrate processing liquid concentration in the liquid in the tank which overflows said substrate processing liquid concentration detecting element from said processing tub.

[Claim 4] The substrate processor which has the temperature detecting element which claim 1 thru/or 3 are the substrate processors of a publication either, and detects the temperature of the liquid in the tank in said processing tub, and the immersion time amount amendment section which amends said substrate immersion time amount on which it decided according to the this detected liquid-in-the-tank temperature.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the substrate processor which is immersed in the diluted solution of substrate processing liquid, such as substrate washing and etching, and processes various substrates called the glass substrate for a semi-conductor wafer or liquid crystal panels in a processing tub.
[0002]
[Description of the Prior Art] Conventionally, with this kind of substrate processor, for example, the substrate processor which gives a substrate to etching processing in fluoric acid (henceforth HF), the substrate is contained to the processing tub, pure water and HF water solution are supplied to this processing tub, the diluted solution of HF water solution is prepared, and substrate processing, i.e., etching, is performed in this dilution HF water solution because predetermined carries out time amount immersion of the substrate. Moreover, in the substrate processor which washes a substrate, HF water solution is replaced, drug solutions (substrate processing liquid), such as hydrogen peroxide solution and aqueous ammonia, are supplied to a processing tub, and the diluted solution of these drug solutions performs substrate processing slack substrate washing.
[0003] If it is in such a substrate processor, depending for the quality of the substrate processing on the dilution preparation concentration of the substrate processing liquid in a processing tub is found well. For this reason, various techniques are proposed in supply of pure water or substrate processing liquid. For example, the technique of adjusting the amount of supply of substrate processing liquid is proposed so that it may become the amount of supply by which substrate processing liquid was mixed to pure water, dilution preparation was carried out in the supply line of pure water, the amount of supply of the substrate processing liquid after the dilution preparation was measured to publication of unexamined utility model application Heisei 4-99269, and the measurement amount of supply of substrate processing liquid was beforehand set to it. Moreover, the technique of adjusting the amount of supply of substrate processing liquid is proposed, respectively so that it may become the concentration by which substrate processing liquid was mixed to pure water, dilution preparation was carried out in the supply line of pure water, the concentration of the substrate processing liquid after dilution preparation was detected to publication of unexamined utility model application Heisei 5-53241, and the detection concentration was beforehand set to it. And these Prior arts make predetermined concentration dilution preparation concentration of substrate processing liquid through accommodation of the amount of supply of substrate processing liquid, and maintain the quality of substrate processing.

[0004]
[Problem(s) to be Solved by the Invention] However, even if it was in the above-mentioned conventional substrate processor, deterioration of substrate processing quality might be seen. It is possible that substrate processing quality deteriorates in spite of performing amount-of-supply accommodation of substrate processing liquid, as described above as follows.
[0005] Since substrate processing liquid is diluted with pure water, if the amount of supply and

the supply pressure of pure water are changed, even when the amount of supply of substrate processing liquid is uniform, flow rate with pure water will change and the dilution concentration will change. Since the fluctuation about supply of this pure water is influenced by the system operating status of other equipments which use the serviceability and pure water in the pure-water feeder which is a primary side to a substrate processor, it has a possibility of occurring unescapable. In addition, since pressure fluctuation of a pure-water supply pressure cannot be lost even if it installs and carries out control of flow of the flow control valve etc. to the supply line of pure water, it does not become essential solution.
[0006] That is, dilution preparation of the substrate processing liquid which let accommodation of the amount of supply of substrate processing liquid pass like the above-mentioned Prior art performs, and a possibility may become that tailing extent by the amount of etching or the washing drug solution is uneven, and may bring deterioration of substrate processing quality by dilution concentration change of the substrate processing liquid resulting from a pure-water supply side is only at only predetermined time amount having been immersed in dilution substrate processing liquid in the substrate.
[0007] Moreover, if the concentration changes to the container concerned at each time which supplies new substrate processing liquid if the concentration of the original substrate processing liquid mixed to pure water changes even if it is the case where the amount of supply or pressure fluctuation are not in the supply side of pure water and it will explain more concretely whenever it will exchange the reservoir container of substrate processing liquid or, even if uniform, the dilution concentration after mixing with pure water will change the amount of supply of substrate processing liquid. Therefore, since there is a possibility that substrate processing quality may deteriorate also in such a case, the severe concentration management at substrate processing liquid itself, every makeup, etc. is needed, and the treatment of substrate processing liquid is complicated. Furthermore, when fluctuation occurs in the electrical potential difference impressed to the feeding pump in the duct of substrate processing liquid, fluctuation may be caused to a flow rate with the pump concerned, and dilution concentration may change too.
[0008] This invention is made in order to solve the above-mentioned trouble, and it aims at aiming at maintenance of the processing quality at the time of processing a substrate by simplification of handling of substrate processing liquid, and the diluted solution of substrate processing liquid.
[0009]
[Means for Solving the Problem] The means which the substrate processor according to claim 1 adopted in order to attain this object The processing tub for containing a substrate, being immersed and processing said substrate to the diluted solution of this substrate processing liquid, in response to supply of pure water and substrate processing liquid, A pure-water supply means to supply pure water to this processing tub, and a substrate processing liquid supply means to supply substrate processing liquid to said processing tub, Control this substrate processing liquid supply means and said pure-water supply means, and supply to said processing tub of said pure water and substrate processing liquid and supply interruption are planned. Said substrate processing liquid permutes the pure water in said processing tub so that liquid in the tank may overflow from said processing tub after filling said processing tub with pure water. It is the substrate processor which has the control means which carries out dilution preparation of said substrate processing liquid. Said control means the time check which clocks the elapsed time after the permutation of the pure water in said processing tub with the substrate processing liquid supplied by said substrate processing liquid supply means is started -- with the section The storage section which matches and memorizes the substrate immersion time amount of the substrate in the concentration and said processing tub of said substrate processing liquid, It responds to the substrate processing liquid concentration detecting element which detects the concentration of said substrate processing liquid, and the substrate processing liquid concentration at the time of dilution preparation of said substrate processing liquid which this substrate processing liquid concentration detecting element detected and the storage result of said storage section. the immersion time amount decision section which decides on substrate immersion time amount with substrate processing liquid [finishing / said dilution preparation],

and said time check -- if the section clocks the this determined substrate immersion passage of time, it will carry out having the substrate immersion termination section which stops substrate immersion with substrate processing liquid [finishing / said dilution preparation] as the summary.
[0010] in this case -- a substrate processor according to claim 2 -- said substrate immersion termination section -- said time check -- if the section clocks the this determined substrate immersion passage of time, said pure-water supply means shall be controlled and pure water shall permute substrate processing liquid [finishing / said dilution preparation in said processing tub]
[0011] In a substrate processor according to claim 3, the substrate processing liquid concentration in the liquid in the tank which shall supply pure water or substrate processing liquid for said pure-water supply means and said substrate processing liquid supply means to said processing tub from the pars basilaris ossis occipitalis, and overflows said substrate processing liquid concentration detecting element from said processing tub shall be detected.
[0012] In a substrate processor according to claim 4, it has the temperature detecting element which detects the temperature of the liquid in the tank in said processing tub, and the immersion time amount amendment section which amends said substrate immersion time amount on which it decided according to the this detected liquid-in-the-tank temperature.
[0013]
[Function] In the substrate processor according to claim 1 which has the above-mentioned configuration, the immersion time amount decision section of a control means determines substrate immersion time amount with substrate processing liquid [finishing / dilution preparation] according to the substrate processing liquid concentration and the storage result of the storage section which the substrate processing liquid concentration detecting element detected at the time of dilution preparation of substrate processing liquid. For this reason, it is a certain cause, for example, even if it changes the amount of supply and the supply pressure of pure water, or the concentration of the substrate processing liquid before dilution by pure water changes and the dilution preparation concentration of substrate processing liquid changes, it decides on the substrate immersion time amount according to that dilution concentration that changed.
[0014] one of these -- a time check -- the substrate immersion time amount the section had clocked the elapsed time after the permutation of the pure water in a processing tub is started with the substrate processing liquid supplied by the substrate processing liquid supply means, and determined in the immersion time-amount decision section from permutation initiation of the pure water concerned passed -- a time check -- if clocked by the section, substrate immersion with substrate processing liquid [finishing / dilution preparation] will be stopped by the substrate immersion termination section. Therefore, a substrate receives immersion processing with the substrate processing liquid of the dilution preparation concentration concerned over the substrate immersion time amount on which it decided according to the dilution concentration of substrate processing liquid, and is not given to processing with the substrate processing liquid of dilution preparation concentration after that.
[0015] A substrate processor according to claim 2 performs the termination of substrate immersion with substrate processing liquid [finishing / dilution preparation] in the pure-water permutation of substrate processing liquid [finishing / dilution preparation in the processing tub through control of a pure-water supply means]. Therefore, over the substrate immersion time amount as which the substrate was determined according to the dilution concentration of substrate processing liquid, after immersion processing with the substrate processing liquid of the dilution preparation concentration concerned, washing of substrate processing liquid is given within a processing tub through a pure-water permutation.
[0016] In a substrate processor according to claim 3, supply of the pure water to a processing tub and substrate processing liquid is performed from the pars basilaris ossis occipitalis of a processing tub, and the liquid in the tank which overflows the concentration of substrate processing liquid from a processing tub detects. Since supply of pure water and substrate processing liquid is a thing from the processing bottom of the tank section, substrate processing

liquid and pure water are fully mixed, substrate processing liquid turns into a fully diluted solution at homogeneity, and the dilution concentration of substrate processing liquid reflects this liquid in the tank to overflow in accuracy. Therefore, the dilution concentration and substrate immersion time amount of substrate processing liquid are decided on substrate immersion time amount through detection of exact dilution concentration corresponding to accuracy.
[0017] In a substrate processor according to claim 4, since the immersion time amount amendment section amends substrate immersion time amount according to the liquid-in-the-tank temperature in the processing tub which the temperature detecting element detected, fluctuation of the substrate processing quality by change of the temperature of substrate processing liquid is controlled.
[0018]
[Example] Next, the suitable example of the substrate processor concerning this invention is explained based on a drawing. Drawing 1 is the outline block diagram showing typically the configuration of the substrate processor 10 which immerses for it and etches a substrate into a dilution HF water solution.
[0019] The substrate processor 10 is immersed in the dilution HF water solution diluted with pure water, and carries out etching processing of the substrate W which was equipped with the processing tub 12 formed with quartz glass, and contained it inside the processing tub 12 using the carrier which is not illustrated so that it may illustrate. It is prepared so that the overflow tub 14 by which the liquid in the tank which overflowed the tub concerned flows into opening of this processing tub 12 may enclose the opening concerned. Moreover, the nozzle 16 of a left Uichi pair which spouts pure water (DIW) or a dilution HF water solution in a tub is installed in the processing bottom of the tank section by the processing tub 12, and the temperature sensor 17 which detects the temperature of liquid in the tank is installed in the processing tub side attachment wall. On the other hand, HF concentration detection sensor 15 which detects HF water-solution concentration in the liquid in the tank overflowed in the layer concerned is installed in the overflow tub 14. In addition, as an HF concentration detection sensor 15, the sensor of a charge mold, the sensor of a light transmission mold, etc. can be used.
[0020] The nozzle 16 is made into a nozzle orifice location and nozzle dimensions which do not produce the irregular convection current in a tub in the blowout of pure water etc., and is formed from quartz glass as well as the processing tub 12. Moreover, the liquid in the tank which flowed into the overflow tub 14 is discharged through a drain line 19.
[0021] From the pure-water feeder 18, the pure-water supply line 20 for supplying pure water branches, and is piped by each nozzle 16 of the processing tub 12. The flow control valve 22 which controls the pure-water flow rate which flows the duct concerned, and the flow rate detection sensor 24 which detects that flow rate are formed in this pure-water supply line 20. In addition, the pure-water supply line 20 is intercepted and this flow control valve 22 can also set a pure-water flow rate to 0.
[0022] Moreover, [near the processing tub 12], the HF supply line 28 for supplying HF water solution to the pure-water supply line 20 from sealed HF water-solution reservoir tank 26 branches, and is piped. The flow control valve 30 which controls the flow rate of HF water solution which flows the duct concerned, and the flow rate detection sensor 32 which detects the flow rate are formed in the HF supply line 28. In addition, this flow control valve 30 can also intercept a duct, and can set that flow rate to 0. [as well as a flow control valve 22]
[0023] In addition, HF passage detection sensor 33 which detects that HF water solution passed through the duct of the point concerned is installed in this side which results in the processing tub 12 in the pure-water supply line 20. This HF passage detection sensor 33 is used in order to judge that HF water-solution (dilution HF water solution) permutation of the pure water in the tub concerned by HF water solution supplied in the processing tub 12 was started through passage detection of HF water solution. In this case, HF passage detection sensor 33 can detect duct passage of HF water solution, if it detects whether the fluid which passes through a duct is only pure water, or it is the pure water which HF water solution mixed. Therefore, ph sensor besides HF water-solution concentration detection sensors, such as a sensor of a charge mold and a sensor of a light transmission mold, etc. can be used for HF passage detection sensor 33.

[0024] The nitrogen gas transfer unit 34 which carries out application-of-pressure supply of the pressurized nitrogen gas into a tank is connected to HF water-solution reservoir tank 26 through the nitrogen gas supply duct 36. The flow control valve 38 which controls the flow rate of the nitrogen gas which flows the duct concerned is formed in this nitrogen gas supply duct 36. In addition, this flow control valve 38 can also intercept a duct, and can set that flow rate to 0. [as well as a flow control valve 22]
[0025] Therefore, where the HF supply line 28 is intercepted by the flow control valve 30, only pure water can be supplied for the pure-water supply line 20 to the processing tub 12 from the nozzle 16 of the pars basilaris ossis occipitalis of the processing tub 12 by the flow control valve 22 at open Lycium chinense, and the processing tub 12 can be filled with pure water. Moreover, if a flow control valve 30 opens the HF supply line 28, pouring pure water to the pure-water supply line 20, the dilution HF water solution which pure water and HF water solution were mixed in the upstream, and was diluted with pure water will be supplied to the processing tub 12. And the pure water currently filled with continuing supply of a dilution HF water solution by the processing tub 12 is gradually permuted by the dilution HF water solution, and is overflowed to the overflow tub 14, and the inside of the processing tub 12 is soon filled with a dilution HF water solution.
[0026] Furthermore, if a dilution HF water solution is supplied, a dilution HF water solution will be overflowed to the overflow tub 14. In this case, since the pure water and HF water solution of the mixed state are supplied from the pars basilaris ossis occipitalis of the processing tub 12, the dilution HF water solution with which mixing with pure water and HF water solution progressed also in the processing tub 12, the dilution concentration of HF water solution became uniform, and dilution concentration became homogeneity in this way will overflow to the overflow tub 14. In addition, uniform dilution concentration here does not mean having become homogeneity to the set-up dilution concentration, and means the dilution concentration which becomes settled each time in the pure water by which mixed supply was carried out at the processing tub 12, and HF water solution.
[0027] Supply of the above-mentioned HF water solution is performed by application-of-pressure supply of the nitrogen gas to HF water-solution reservoir tank 26 which passed through the nitrogen gas supply duct 36 from the nitrogen gas transfer unit 34 by lifting of tank internal pressure. Under the present circumstances, flow control is carried out by the flow control valve 38.
[0028] Next, the electronic control 40 which manages the supply control of pure water and HF water solution in the above-mentioned substrate processor 10 is explained.
[0029] The temperature sensor 17 in the processing tub 12 besides the flow rate detection sensor 24 which detects the flow rate in the pure-water supply line 20 or the HF supply line 28 as a signal input device, and the flow rate detection sensor 32, HF concentration detection sensor 15 in the overflow tub 14, and HF passage detection sensor 33 in the pure-water supply line 20 are connected to this electronic control 40, and the detecting signal of each above-mentioned sensor is inputted into an electronic control 40. Moreover, as control signal output equipment, the flow control valve 22, the flow control valve 30, and the flow control valve 38 are connected, and a control signal is outputted to each control valve from an electronic control 40.
[0030] The electronic control 40 which outputs a control signal to the flow-control-valve 22 grade mentioned above based on these detecting signals etc. is constituted as a logic operation circuit centering on CPU42, ROM44, RAM46, and a timer 48, and performs I/O with the exterior with the input/output port 52 mutually connected through these and a common bus 50.
[0031] Next, the substrate immersion processing control (routine) which the electronic control 40 of the substrate processor 10 of this example equipped with the above-mentioned configuration performs is explained based on the flow chart of drawing 2 .
[0032] Substrate W is thrown into the predetermined location of the processing tub 12 by the substrate transport device which is not illustrated, the receipt is completed, and the substrate immersion manipulation routine shown in drawing 2 will be performed if an electronic control 40 receives the completion signal of receipt from a substrate transport device. And initiation of processing starts supply of the pure water to the processing tub 12 first (step S100). Under the

present circumstances, since the control signal which set the control flow rate to the flow control valve 22 in the pure-water supply line 20 is outputted from an electronic control 40, that flow rate is controlled by the flow control valve 22, and pure water is independently supplied to the processing tub 12.
[0033] Then, it stands by until it judges and (step S105) carries out affirmative judgment of whether whether the processing tub's 12 having been filled with pure water and pure water overflowed from the processing tub 12 to the overflow tub 14. Since supply of pure water is continued also while carrying out negative judgment and standing by at this step S105, soon, the processing tub 12 is filled with pure water, pure water will be overflowed to the overflow tub 14, and affirmative judgment will be made at step S105. Specifically, overflow of pure water is judged as follows.
[0034] Since the content volume of the processing tub 12 becomes settled in the design stage of the substrate processor 10, it is using the control flow rate which it was ordered from the flow rate or electronic control 40 which the flow rate detection sensor's 24 detected, and the time amount (pure-water overflow time amount) taken [after pure water is supplied to the processing tub 12] to overflow to the overflow tub 14 can be calculated. Therefore, if it goes through this pure-water overflow time amount after starting supply of pure water at step S100, overflow of pure water can be referred to as having occurred, and decision at step S105 will turn into affirmative judgment. In addition, it can also constitute so that the existence of overflow of pure water may be judged from the situation of the fluid passage in a drain line 19 etc.
[0035] After carrying out affirmative judgment at step S105, supply of HF water solution to the processing tub 12 is started that HF water solution should be supplied to the processing tub 12 filled with pure water, and should be diluted, and a dilution HF water solution should be prepared (step S110). Under the present circumstances, from an electronic control 40, the control signal which set each control flow rate to the flow control valve 38 in the nitrogen gas supply duct 36 and the flow control valve 30 in the HF supply line 28 is outputted. Therefore, the flow rate is controlled by these flow control valves, it mixes in the pure-water supply line 20, and HF water solution is supplied to the processing tub 12 with pure water through the pure-water supply line 20 of the down-stream range. For this reason, HF water solution will be supplied to the processing tub 12, pure water diluting in the pure-water supply line 20. In addition, suppose that each processing is explained, using suitably the timing chart shown in drawing 3 on the occasion of explanation of each following step.
[0036] Time amount t1 shown in drawing 3 by step S110 If it sets and supply of HF water solution is started, at continuing step S115, it will stand by until it judges and carries out affirmative judgment of whether HF water solution was actually supplied to the processing tub 12 based on the detecting signal of HF passage detection sensor 33. This processing is for checking whether HF water solution has been actually supplied to the processing tub 12. For this reason, a case if supply of HF water solution is started at step S110 as shown in drawing 1 , so that HF water solution may reach the processing tub 12 immediately, and in the configuration which is not illustrated as the HF supply line 28 is piped by the direct nozzle 16, step S115 can also be skipped. In addition, unless you show clearly especially in the following explanation, if supply of HF water solution is started, suppose that HF water solution reaches the processing tub 12 immediately.
[0037] If affirmative judgment is carried out to HF water solution having been actually supplied to the processing tub 12 at this step S115, the dilution HF water-solution permutation of dilution of HF water solution by the stored pure water in the processing tub 12 and stored pure water will be started. therefore, it is shown in drawing 3 -- as -- time amount t1 the time check by the timer 48 of the elapsed time (mixed supply time amount) Ts if it sets and affirmative judgment is carried out at step S115, after HF water solution will be actually supplied to the processing tub 12 with pure water -- time amount t1 from -- it starts (step S120). It stands by until it judges and (step S125) carries out affirmative judgment of whether to have overflowed altogether pure water [finishing / whether the processing tub 12 was filled with the dilution HF water solution diluted with pure water, and a reservoir] from the processing tub 12 to the overflow tub 14, and to also have overflowed the dilution HF water solution concerned to the overflow tub 14 further

after that.
[0038] By the way, it is as follows in not reaching the processing tub 12 immediately after supply initiation, even if supply of HF water solution is started, since the HF supply line 28 separates from the processing tub 12 and is connected to the pure-water supply line 20. That is, time amount **t after starting supply of HF water solution at step S110 until HF water solution reaches the processing tub 12 becomes settled by the duct length from the connection place of the flow rate of pure water or HF water solution, the rate of flow in tubing, and the HF supply line 28 to the processing tub 12 etc. Therefore, elapsed time Ts according [on step S125 and] to a timer 48 when HF water solution does not reach the processing tub 12 immediately after the supply initiation Time amount t1 which starts a time check Only the above-mentioned time amount **t should perform step S110 in front. Under the present circumstances, it is time amount t1 by the step S115 after starting supply of HF water solution at step S100. Since it is specified, it is not necessary to calculate the above-mentioned time amount **t.
[0039] Also while carrying out negative judgment and standing by at the above-mentioned step S125, supply with pure water and HF water solution is continued. For this reason, all pure water [finishing / a reservoir / soon] is permuted by the dilution HF water solution, the processing tub 12 will be filled with this dilution HF water solution, a dilution HF water solution will be overflowed to the overflow tub 14, and affirmative judgment will be made at step S125. In this case, overflow of a dilution HF water solution is judged like step S105.
[0040] That is, HF water-solution overflow time amount is calculated using the control flow rate which ordered it first the content volume of the processing tub 12 from the flow rate or electronic control 40 of the pure water which the flow rate detection sensor 24 and the flow rate detection sensor 32 detected, and HF water solution. and time amount t1 by which HF water solution was actually supplied to the processing tub 12 from -- time amount t2 in which overflow of a dilution HF water solution occurred the time amount in which this calculated HF water-solution overflow time amount passed ** -- it carries out. In addition, at this example, it is this time amount t2. Time amount t3 in which only predetermined time passed It is constituted so that it may set and affirmative judgment may be carried out at step S125.
[0041] Moreover, it can also constitute so that a judgment at this step S125 may be made as follows. Since supply of HF water solution to the processing tub 12 is started under the situation that the processing tub 12 was already filled with pure water, as shown in drawing 3 , stored pure water is permuted by HF water solution with the passage of time from the supply initiation event (time amount t1). For this reason, the dilution concentration of HF water solution in the processing tub 12 rises with the passage of time, and is stabilized soon. That is, the dilution concentration of HF water solution in the processing tub 12 will be stabilized to the dilution concentration (HF1) which becomes settled each time with the actual flow rate of the pure water by which mixed supply is carried out at the processing tub 12, and HF water solution, HF water-solution concentration in HF water-solution reservoir tank 26, etc., if the processing tub 12 is filled with a dilution HF water solution and a dilution HF water solution comes to overflow. Therefore, it scans for every predetermined time by the measurement routine which does not illustrate HF concentration detection sensor 15 formed in the overflow tub 14, and if the detection concentration difference for the scan of every changes to a very small value, it constitutes so that the control signal of the purport that overflow of a dilution HF water solution occurred may be taken out from a measurement routine. And it constitutes so that affirmative judgment of this control signal may be carried out at the carrier beam event (time amount t3) at step S125.
[0042] If the affirmative judgment in step S125 is followed, the control signal of a flow rate 0 is outputted to a flow control valve 22, a flow control valve 30, and a flow control valve 38, and supply of the pure water to the processing tub 12 and HF water solution is suspended (step S130). Therefore, it is the dilution concentration HF 1 which the processing tub 12 described above after that. Being in a condition [being filled with the dilution HF water solution in which that dilution concentration became homogeneity], Substrate W is this dilution concentration HF 1. It is immersed and etched into a dilution HF water solution.
[0043] Next, this dilution concentration HF 1 Reading (step S140) from HF concentration

detection sensor 15 and reading (step S150) from the temperature sensor 17 of the temperature (solution temperature in a tub) of the dilution HF water solution in the processing tub 12 are performed. Then, read dilution concentration HF 1 The substrate immersion time amount THF immersed in Substrate W is computed as follows (step S160).

[0044] First, read dilution concentration HF 1 Substrate immersion time amount is once computed through interpolation count from the map corresponding to the graph of HF water-solution concentration shown in drawing 4 , and the substrate immersion time amount THF. In case this graph obtains the same amount of substrate etching, HF water-solution concentration and immersion time amount are defined experimentally beforehand, and the map corresponding to the graph concerned is memorized by ROM44. Next, dilution concentration HF 1 which read the value amended by the solution temperature in a tub which read this computed substrate processing time Substrate immersion time amount THF1 actually immersed in Substrate W It carries out. therefore, the flow rate of pure water and HF water solution etc. changes by a certain cause, for example, the pure-water amount of supply, fluctuation of a supply pressure, etc., and the newly read dilution concentration shows drawing 3 -- as -- the last dilution concentration HF 1 Low dilution concentration HF 2 it is -- if -- this dilution concentration HF 2 the substrate immersion time amount THF actually immersed in Substrate W -- THF1 Long substrate immersion time amount THF2 ****** -- it is computed.

[0045] In addition, even if it is the dilution HF water solution of the same dilution concentration, if the solution temperature is high, since etching by immersion advances more, it will amend substrate immersion time amount THF by the solution temperature in a tub. That is, if the solution temperature in a tub is high compared with the solution temperature used as criteria, the substrate processing time will be amended to a reduction side, and if low, it will amend to a buildup side.

[0046] In this way, elapsed time Ts to which a timer 48 will clock whether this computed substrate immersion time amount THF (THF [1] and THF2) has passed HF water solution in it after starting supply to the processing tub 12 if the substrate immersion time amount THF is computed through a temperature compensation operation It minds and judges (step S165). And elapsed time Ts It stands by, while carrying out negative judgment, if the computed substrate immersion time amount THF (THF [1] and THF2) is not reached.

[0047] Therefore, [the time amount which carries out negative judgment and is standing by at step S165], Substrate W is immersed and etched into a dilution HF water solution, and the substrate immersion time amount THF which influences the amount slack processing quality of etching is changed each time with the actual dilution concentration at that time of a dilution HF water solution. concrete -- the dilution concentration of a dilution HF water solution -- HF1 it is -- if -- Substrate W -- substrate immersion time amount THF1 it is continued and immersed -- having -- dilution concentration -- HF2 it is -- if -- Substrate W -- substrate immersion time amount THF2 It will be continued and immersed.

[0048] On the other hand, if it judges that it is Ts = substrate immersion time amount THF (THF [1] and THF2) at step S165, it will be elapsed time Ts. A value 0 is set (step S170) and, subsequently supply of the pure water stopped till then is started (step S180). that is, the dilution concentration of a dilution HF water solution -- HF1 it is -- if -- substrate immersion time amount THF1 After the time amount t4 (t1+THF1) which passed through the substrate immersion which continues moreover, dilution concentration -- HF2 it is -- if -- substrate immersion time amount THF2 After the time amount t5 (t1+THF2) which passed through the substrate immersion which continues, immersion processing of the substrate W in the dilution concentration (HF1 and HF2) concerned will be stopped. And time amount t4 Or time amount t5 Since the dilution HF water solution in the processing tub 12 is permuted with pure water by supply of pure water afterwards and the processing tub 12 is soon filled with pure water, Substrate W is washed by pure water in the meantime.

[0049] In case supply of pure water is started in this step S180, that flow rate is controlled as follows. If pure water is supplied to the processing tub 12, since the inside of the processing tub 12 will be gradually permuted by pure water from a dilution HF water solution, HF water-solution concentration from permutation initiation (time amount t4 or time amount t5) changes, as shown

in drawing 3 . The situation at the time of this pure-water permutation is shown in drawing 5 together with the situation at the time of the inside of the processing tub 12 being permuted by HF water solution. In addition, about a pure-water permutation, permutation initiation is time amount t4. Only a case is shown.
[0050] As shown in this drawing 5 , it is time amount t4. Since HF water solution remains in the processing tub 12 also after a pure-water permutation is started, it is thought that Substrate W is etched also after initiation of a pure-water permutation in the residual dilution HF water solution which remains in the processing tub 12. if it explains in more detail -- Substrate W -- time amount t4 from -- time amount t6 from which the concentration of HF water solution serves as zero up to -- dilution concentration [in / it continues in between and / in the concentration / substrate immersion time amount] HF 1 It is thought that it is etched in the residual dilution HF water solution which falls low and gradually. And the amount of etching in the meantime (the amount of superfluous etching) is the area S1 of the range shown with a slash in drawing 5 , when expressed in geometry. It corresponds.
[0051] At the time of the substrate processing initiation which supplies HF water solution to the processing tub 12 on the other hand, it is time amount t1. Also after a dilution HF water-solution permutation is started, pure water remains in the processing tub 12. for this reason, time amount t1 from -- the concentration of HF water solution -- dilution concentration HF 1 Becoming time amount t2 up to -- in between, it is thought that Substrate W is etched in the dilution HF water solution which increases from concentration zero to the dilution concentration HF 1 in substrate immersion time amount gradually. And etching ullage (difference of the amount of etching of a before [from the time amount t1 by HF water solution of the dilution concentration HF 1 / time amount t2] and the amount of etching of a before [from the time amount t1 by the dilution HF water solution of the concentration which increases to the dilution concentration HF 1 gradually / time amount t2]) in the meantime is the area S0 of the range shown with a slash in drawing 5 , when expressed in geometry. It corresponds.
[0052] Therefore, it is specifically the area S1 in drawing 5 so that the above-mentioned amount of superfluous etching and etching ullage may become equal at step S180. Area S0 The pure-water flow rate in the case of pure-water supply is controlled in agreement.
[0053] a ****** [that washing by the pure water of Substrate W was completed if step S180 accompanied by control of a pure-water flow rate which was described above was followed] -- time amount t4 Or time amount t5 from -- it judges through progress of predetermined time (step S185), and if pure-water washing is completed, supply of pure water will be suspended (step S190). Subsequently, a substrate taking-out command signal is outputted in order to take out Substrate W out of the processing tub 12 noting that all processings of the substrate W in the processing tub 12 are completed by completion of pure-water washing (step S200), and this routine is once ended. The substrate transport device which is not illustrated takes out Substrate W from the processing tub 12 in response to this substrate taking-out command signal.
[0054] By the way, in a configuration as are mentioned already, and the HF supply line 28 separates from the processing tub 12 and is connected to the pure-water supply line 20, while HF water solution has been the dilution concentration at the time of substrate immersion processing, it remains in the duct of the pure-water supply line 20 from the connection place of the HF supply line 28 to the processing tub 12. For this reason, in a such configuration, even if it starts supply of pure water at step S180, pure water does not reach the processing tub 12 immediately, but HF water solution in tubing is also supplied at the beginning of supply initiation, and it is predetermined time **t0. Pure water is supplied only to behind at the processing tub 12. That is, after pure-water supply is started at step S180, it is predetermined time **t0. After progress, the pure-water permutation in a processing tub starts. Therefore, what is necessary is just to perform pure-water supply by step S180 as follows in a configuration as the HF supply line 28 separates from the processing tub 12 and is connected to the pure-water supply line 20. First, above predetermined time **t0 It computes by the duct length from the connection place of the flow rate of pure water and HF water solution till then, the rate of flow in tubing, and the HF supply line 28 to the processing tub 12 etc. and time amount t4 from which the pure-water

permutation in the processing tub 12 begins Or time amount t5 predetermined time **t 0 -- before -- or (substrate immersion time amount THF-**t0) the time amount to calculate -- time amount t1 from -- after passing -- step S180 -- performing -- pure-water supply -- time amount t4 or the time amount t5 -- **t0 only -- what is necessary is just to start a little early In addition, this predetermined time **t0 Since calculation is completed in substrate immersion time amount, it is convenient.

[0055] As explained above, even if the flow rate of pure water and HF water solution changes by fluctuation of the pure-water amount of supply or a supply pressure, or HF water-solution concentration changes with exchange of HF water-solution reservoir tank 26 and it changes at each time whose dilution concentration of the dilution HF water solution in the processing tub 12 is substrate processing, according to the change, the substrate processor 10 of this example changes the substrate immersion time amount THF of Substrate W, and is set up. Furthermore, when it passes through the immersion of Substrate W covering the substrate immersion time amount THF in the dilution HF water solution of the dilution concentration at every processing in the processing tub 12, the substrate processor 10 stops substrate immersion with the dilution HF water solution of the subsequent dilution concentration concerned, and gives Substrate W to pure-water washing.

[0056] For this reason, since it depends by the dilution concentration and its immersion time amount of a dilution HF water solution, according to the substrate processor 10 of this example, through a response with the dilution concentration and immersion time amount of a dilution HF water solution, the amount of etching which is the processing quality of Substrate W can attain equalization of the amount of etching, and can maintain that processing quality. Moreover, since according to the substrate processor 10 the amount of etching, as a result processing quality are maintainable even if the concentration of HF water solution changes with exchange of HF water-solution reservoir tank 26, it becomes unnecessary to manage strictly HF water-solution concentration of HF water-solution reservoir tank 26, and the handling can be simplified.

[0057] Moreover, in the substrate processor 10, since Substrate W is given to pure-water washing after being substrate immersed in a dilution HF water solution, it can take out, without making a dilution HF water solution adhere to Substrate W. Therefore, according to the substrate processor 10, unprepared etching after substrate immersion is avoidable. Moreover, since it is pure-water washing ending, it is convenient for an after process.

[0058] Furthermore, this substrate processor 10 performs mixed supply of the pure water to the processing tub 12, and HF water solution from the pars basilaris ossis occipitalis of a tub by the nozzle 16. Therefore, also in the processing tub 12, mixing with pure water and HF water solution is advanced, dilution concentration of HF water solution is made into the dilution concentration of the homogeneity which becomes settled by the pure-water flow rate at that time, HF water-solution flow rate, etc., and the overflow tub 14 is made to overflow the dilution HF water solution used as the dilution concentration of this homogeneity. And the liquid in the tank (dilution HF water solution) overflowed from the processing tub 12 by HF concentration detection sensor 15 detects the dilution concentration equalized in this way. For this reason, since exact substrate immersion time amount can be set up through detection of the exact dilution concentration of the dilution HF water solution in the processing tub 12 according to the substrate processor 10, the amount of etching can be made to be able to equalize further and maintenance and improvement in processing quality can be aimed at.

[0059] Moreover, the substrate processor 10 carries out increase and decrease of the substrate immersion time amount of Substrate W of amendment with the temperature of the dilution HF water solution in the processing tub 12, and attains rationalization of substrate immersion time amount. Therefore, according to the substrate processor 10, fluctuation of the amount of etching by change of the temperature of the dilution HF water solution in the processing tub 12 can be controlled, and maintenance and improvement in processing quality can be aimed at.

[0060] Furthermore, there are the following advantages in the substrate processor 10 of this example. Since the nozzle 16 of the processing tub 12 is a product made from quartz glass, although there is few the extent, small [every] corrosion, i.e., when etched, has the nozzle orifice of a nozzle 16 with a dilution HF water solution. therefore, according to the substrate

processor 10, substrate immersion time amount is defined according to the actual dilution concentration of a dilution HF water solution -- it can come out and the amount of etching of the nozzle orifice of the nozzle 16 of the processing tub 12 can be made uniform at every substrate processing. For this reason, in such a case, fluctuation unprepared to the pure water to the processing tub 12 or the inflow per unit time amount of HF water solution cannot be caused, but pure water and HF water solution can be made to flow into it to the processing tub 12 with a stable inflow.
[0061] Moreover, as shown in drawing 5 , it let the pure-water control of flow at the time of a pure-water permutation pass, and the amount of superfluous etching at the time of a pure-water permutation and the etching ullage of the time of substrate processing initiation were made in agreement in the substrate processor 10. For this reason, according to the substrate processor 10, maintenance of high processing quality can be aimed at through much more equalization of the amount of etching.
[0062] Although one example of this invention was explained above, as for this invention, it is needless to say that it can carry out in the mode which becomes various in the range which is not limited to such an example at all and does not deviate from the summary of this invention.
[0063] For example, it constituted so that HF passage detection sensor 33 might detect initiation of the dilution HF water-solution permutation of pure water, but without using HF passage detection sensor 33, it can also constitute as follows so that this dilution HF water-solution permutation initiation may be detected.
[0064] In the design stage of the substrate processor 10, since the effective duct area and the duct length of the pure-water supply line 20 or the HF supply line 28 become settled, time amount (HF time of concentration) until HF water solution reaches to the processing tub 12 from the mixing initiation to the pure-water supply line 20 of HF water solution from the detection flow rate of these design values, the flow rate detection sensor 24, and the flow rate detection sensor 32 can be calculated. Therefore, what is necessary is just to process the event of HF time of concentration passing as a time of dilution HF water-solution permutation initiation of the pure water in the processing tub 12, after mixing HF water solution to the pure-water supply line 20 by the flow control valve 30. Specifically, it is the mixed supply time amount [in / when HF time of concentration has passed since the time of mixing to the pure-water supply line 20 of HF water solution / step S120] Ts. What is necessary is just to constitute so that it may clock. Thus, if constituted, HF passage detection sensor 33 becomes unnecessary, and simplification of a configuration can be attained.
[0065] Furthermore, although the above-mentioned example explained the case where substrate processing was carried out in the dilution water solution of single substrate processing liquid (HF water solution), also when carrying out substrate processing with the dilution water solution of two or more substrate processing liquid with dilution substrate processing liquid, such as substrate processing, for example, hydrogen peroxide solution, and aqueous ammonia, of course, this invention is applicable. In this case, what is necessary is just to detect the concentration for every substrate processing liquid.
[0066] Moreover, the duct was constituted from an above-mentioned example so that HF water solution might be mixed in the pure-water supply line 20, but as shown in drawing 6 , the pure-water supply line 20 and the HF supply line 28 can also be constituted so that it may result according to an individual at the processing tub 12, respectively. In this case, since the time of dilution HF water-solution permutation initiation of the pure water in the processing tub 12 becomes settled as a time of the duct disconnection by the flow control valve 30, HF passage detection sensor 33 becomes unnecessary, and simplification of a configuration can be attained.
[0067] Moreover, although the configuration which supplies pure water independently after completing substrate immersion processing with a dilution HF water solution, carries out the pure-water permutation of the inside of the processing tub 12 in the above-mentioned example, and washes a substrate explained, the configuration of taking out Substrate W from the processing tub 12 after completing substrate immersion processing with a dilution HF water solution, or discharging the dilution HF water solution in the processing tub 12 can also take. In addition, although the configuration which also supplies pure water was explained in the above-

mentioned example when supplying HF water solution to the processing tub 12, also when suspending supply of pure water in the case of supply of HF water solution and diluting HF water solution with the pure water in the processing tub 12, of course, it can apply.
[0068]
[Effect of the Invention] As explained in full detail above, a substrate processor according to claim 1 Even if the dilution preparation concentration of the substrate processing liquid at every substrate processing changes by a certain cause According to that change, it decides on substrate immersion time amount with the substrate processing liquid of that dilution preparation concentration, and if it passes after a substrate processing liquid permutation [in / in this substrate immersion time amount on which it decided / a processing tub] is started, substrate immersion with substrate processing liquid [finishing / dilution preparation] will be stopped. Therefore, according to the substrate processor according to claim 1, substrate processing quality is maintainable by aiming at a response with the dilution preparation concentration of substrate processing liquid and substrate immersion time amount with which immersion of a substrate is presented actually. And in a substrate processor according to claim 1, even if the concentration changes with exchange of the reservoir tank of substrate processing liquid, processing extent in immersion processing of a substrate, as a result processing quality are maintainable. For this reason, according to the substrate processor according to claim 1, it becomes unnecessary to manage the concentration of substrate processing liquid itself strictly, and that handling can be simplified.
[0069] A substrate processor according to claim 2 performs the termination of substrate immersion with substrate processing liquid [finishing / dilution preparation] in the pure-water permutation of substrate processing liquid [finishing / dilution preparation in a processing tub]. Therefore, since it does not carry out to having made substrate processing liquid freely adhere to the substrate after substrate immersion processing according to the substrate processor according to claim 2, progress of the unprepared substrate processing after immersion processing with the substrate processing liquid of dilution preparation concentration is avoidable. Moreover, since it is pure-water washing ending through a pure-water permutation, it is convenient for an after process.
[0070] In a substrate processor according to claim 3, dilution preparation concentration is made to equalize through supply of the pure water from the processing bottom of the tank section, and substrate processing liquid, and the dilution preparation concentration of the substrate processing liquid overflowed by the dilution concentration used as homogeneity is detected. For this reason, according to the substrate processor according to claim 3, since the dilution concentration and substrate immersion time amount of substrate processing liquid can be decided on substrate immersion time amount through detection of exact dilution preparation concentration corresponding to accuracy, that maintenance can be aimed at in the improvement list of the processing quality of substrate processing.
[0071] It is made to correspond also to the liquid-in-the-tank temperature at every substrate processing of the substrate immersion time amount made to correspond to change of the dilution preparation concentration of the substrate processing liquid at every substrate processing in a substrate processor according to claim 4. For this reason, according to the substrate processor according to claim 4, fluctuation of processing extent with substrate processing liquid can be controlled, and maintenance and improvement in substrate processing quality can be aimed at.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The outline block diagram showing typically the configuration of the substrate processor 10 which immerses for it and etches a substrate into a dilution fluoric acid solution.
[Drawing 2] The flow chart which shows the substrate immersion manipulation routine which an electronic control 40 performs.
[Drawing 3] The timing chart for explaining the content of the processing in a substrate immersion manipulation routine.
[Drawing 4] The graph for explaining the content of the processing in a substrate immersion manipulation routine.
[Drawing 5] The explanatory view for explaining the content of the processing in a substrate immersion manipulation routine.
[Drawing 6] The outline block diagram showing the configuration of other examples of the substrate processor 10 typically.
[Description of Notations]
10 -- Substrate processor
12 -- Processing tub
14 -- Overflow tub
15 -- HF concentration detection sensor
16 -- Nozzle
17 -- Temperature sensor
18 -- Pure-water feeder
20 -- Pure-water supply line
22 -- Flow control valve
24 -- Flow rate detection sensor
26 -- HF water-solution reservoir tank
28 -- HF supply line
30 -- Flow control valve
32 -- Flow rate detection sensor
33 -- HF passage detection sensor
34 -- Nitrogen gas transfer unit
36 -- Nitrogen gas supply duct
38 -- Flow control valve
40 -- Electronic control
42 -- CPU
44 -- ROM
46 -- RAM
48 -- Timer
W -- Substrate

[Translation done.]